CLAIMS

1. Optical fiber comprising:
   - a glass portion;
   - at least one protective coating layer disposed to surround said glass portion;

   said protective coating layer having a modulus of elasticity value between -40°C and +60°C comprised between 5 MPa and 600 MPa.
2. Optical fiber according to claim 1, wherein the modulus of elasticity value is not higher than 500 MPa.
3. Optical fiber according to claim 2, wherein the modulus of elasticity value is not higher than 450 MPa.
4. Optical fiber according to claim 3, wherein the modulus of elasticity value is not higher than 300 MPa.
5. Optical fiber according to claim 1, wherein the modulus of elasticity value is not lower than 8 MPa.
6. Optical fiber according to claim 4, wherein the modulus of elasticity value is higher than 12 MPa.
7. Optical fiber according to any one of claims 1 to 6, wherein the protective coating layer is disposed in contact with said glass portion.
8. Optical fiber according to any one of claim 1 to 6, wherein the protective coating layer is a single protective coating layer which is disposed in contact with said glass portion.
9. Optical fiber according to any one of claim 1 to 8, wherein the variation (V_1) between the modulus of elasticity value measured at -40°C and the modulus of elasticity value measured at at +60°C of the protective coating layer, is not higher than 495 MPa.
10. Optical fiber according to claim 9, wherein the

variation (V_1) between the modulus of elasticity value measured at -40°C and the modulus of elasticity value measured at +60°C of the protective coating layer is not higher than 320 MPa.

11. Optical fiber according to claim 10, wherein the variation (V_1) between the modulus of elasticity value measured at -40°C and the modulus of elasticity value measured at +60°C of the protective coating layer is not higher than 150 MPa.

12. Optical fiber according to any one of claims 1 to 11, wherein the protective coating layer has an equilibrium modulus (E.M.) higher than 5 MPa.

13. Optical fiber according to any one of claims 1 to 12, wherein the microbending variation (V_2) between -40°C and +60°C, measured by winding a 100 m lenght fiber with a tension of 5 g on a 300 mm diameter expandable metallic bobbin coated with rough material, is not higher than 20 (dB/km)/(g/mm).

14. Optical fiber according to claim 13, wherein the microbending variation (V_2) between -40°C and +60°C, measured by winding a 100 m lenght fiber with a tension of 5 g on a 300 mm diameter expandable metallic bobbin coated with rough material, is not higher than 15 (dB/km)/(g/mm).

15. Optical fiber according to claim 14, wherein the microbending variation (V_2) between -40°C and +60°C, measured by winding a 100 m lenght fiber with a tension of 5 g on a 300 mm diameter expandable metallic bobbin coated with rough material, is not higher than 6 (dB/km)/(g/mm).

16. Optical fiber according to any one of claims 1 to 15 wherein the protective coating is obtained by curing a radiation curable composition comprising:

(a) at least one ethylenically unsaturated polyurethane having a glass transition

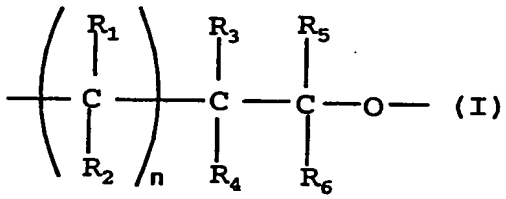
temperature (T_g) comprised between -40°C and -100°C;

(b) at least one polyfunctional reactive diluent monomer.

17. Optical fiber according to claim 16, wherein the ethylenically unsaturated polyurethane (a) has a glass transition temperature (T_g) comprised between -50°C and -85°C.

18. Optical fiber according to claims 16 or 17, wherein the ethylenically unsaturated polyurethane (a) is obtained by reacting the following compounds:

(A) at least one polyol compound comprising a structural unit represented by the following formula (I):



(I)

wherein n is an integer comprised from 0 to 4 inclusive; R_1, R_2, R_3, R_4, R_5 and R_6, which may be equal or different from each other, represent a hydrogen atom or a C_1-C_4 alkyl group;

(B) at least one polyisocyanate compound; and

(C) at least one (meth)acrylate compound containing at least one hydroxyl group.

19. Optical fiber according to claim 18, wherein the polyol type compounds (A) are selected from: compounds obtained by polymerizing at least one compound selected from ethylene glycol, polyethylene glycol, propylene glycol, polypropylene glycol, tetramethylene glycol, 2-alkyl-1,4-butanediol and 3-alkyl-1,4-butanediol; compounds obtained by ring-opening polymerization of 2-alkyl-tetrahydrofuran or 3-alkyl-tetrahydrofuran; compounds obtained by

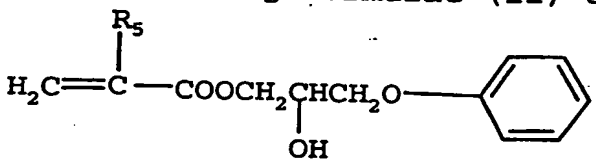
copolymerization of 2-alkyl-tetrahydrofuran, 3-alkyl-tetrahydrofuran or 2-alkyl-1,4-butanediol, with a cyclic ether such as ethylene oxide, propylene oxide and tetrahydrofuran, or mixtures thereof.

20. Optical fiber according to claim 18, wherein the polyol type compound (A) is selected from: polybutadiene with a terminal hydroxyl group, hydrogenated polybutadiene with a terminal hydroxyl group, polyisobutylene polyol, 1,6-hexanediol, neopentyl glycol, 1,4-cyclohexane dimethanol, bisphenol A, bisphenol F, alkylene oxide adducts of bisphenol A, alkylene oxide adducts of bisphenol F, dimethylolized compound of dicyclopentadiene, polyester diols, polycaprolactone diols, polycarbonate diols, or mixture thereof.

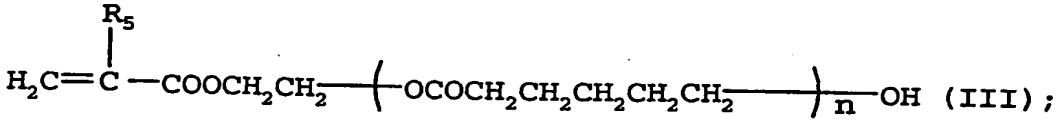
21. Optical fiber according to any one of claims 18 to 20, wherein the polyisocyanate compound (B) is selected from: polyisocyanates of 2,4-tolylenediisocyanate, 2,6-tolylenediisocyanate, 1,3-xylenediiso-cyanate, 1,4-xylenediisocyanate, 1,5-naphthalenediisocyanate, m-phenylenediiso-cyanate, p-phenylenediisocyanate, 3,3'-dimethyl-4,4'-diphenylmethanediisocyanate, 4,4'-diphenyl-methanediisocyanate, 3,3'-dimethylphenylene-diisocyanate, 4,4'-biphenylenediisocyanate, 1,6-hexamethylenediisocyanate, isophoronediiso-cyanate, methylenebis(4-cyclohexylisocyanate), 2,2,4-trimethylhexamethylenediisocyanate, 2,4,4-trimethylhexamethylenediisocyanate, 1,4-hexa-methylenediisocyanate, bis(2-isocyanateethyl)-fumarate, 6-isopropyl-1,3-phenyldiisocyanate, 4-diphenylpropaneisocyanate, lysinediisocyanate, or mixtures thereof.

22. Optical fiber according to any one of claim 18 to 21, wherein the (meth)acrylate compound having at least one hydroxyl group (C) is selected from: 2-

hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)-acrylate, 2-hydroxy-3-phenyloxypropyl (meth)-acrylate, propanediol (meth)acrylate, 1,4-butanediol mono(meth)acrylate, 2-hydroxyalkyl (meth)acryloyl phosphate, 4-hydroxycyclohexyl (meth)acrylate, 1,6-hexanediol mono(meth)acrylate, neopentylglycol mono(meth)-acrylate, trimethylolpropane di(meth)acrylate, trimethylolethane di(meth)acrylate, penta-erythrithol tri(meth)acrylate, dipenta-erythritol penta(meth)acrylate, (meth)acrylates represented by the following formulae (II) or (III):



(II);



(III);

wherein R_5 represents a hydrogen atom or a methyl group and n is an integer of from 1 to 15 inclusive; or mixtures thereof.

23. Optical fiber according to any one of claims 16 to 22, wherein the polyfunctional reactive diluent monomer (b) is selected from: ethylene glycol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, propanediol di(meth)acrylate, 1,4-butanediol di(meth)acrylate, trimethylolpropane di(meth)acrylate, trimethylolpropane tri(meth)acrylate, neopently glycol di(meth)acrylate, 1,6-hexanediol di(meth)acrylate, 1,6-hexamethylenedihydroxy di(meth)acrylate, polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, hydroxypivalic acid neopentyl glycol ester di(meth)acrylate, trimethylolpropane tri(meth)acrylate, trimethylolpropanetrioxyethyl (meth)acrylate, tricyclodecanedimethanol di(meth)acrylate,

dicyclopentadiene di(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, pentaerythritol trioxyethyl (meth)acrylate, pentaerythritol tetraoxyethyl (meth)acrylate, di(meth)acrylate of a diol such as the addition compound of ethylene oxide or propylene oxide with bisphenol A, hydrogenated bisphenol A glycidyl ether of bisphenol A, or mixtures thereof.

24. Optical fiber according to claims 23, wherein the polyfunctional reactive diluent monomer (b) is 1,6-hexane diol diacrylate, pentaerythritol triacrylate, or a mixture of pentaerythritol triacrylate and pentaerythritol tetraacrylate.

25. Optical fiber according to any one of claims 16 to 24, wherein the radiation curable coomposition comprises at least one polymerization initiator (c).

26. Optical fiber according to claim 25, wherein the polymerization initiator (c) is selected from: benzophenone, benzoin, benzoinisobutyl ether, benzil, benzoinethyl ether, 2,2-dimethoxy-2-phenylacetophenone, xanthone, fluorenone, 4-chlorobenzophenone, triphenylamine, carbazole, 3-methylacetophenone, 4,4'-dimethoxybenzo-phenone, 4,4'-diaminobenzophenone, Michler's ketone, benzoin propyl ether, acetophenone diethyl ketal, benzoin ethyl ether, 1-hydroxycyclohexylphenyl ketone, 2-hydroxy-2-methylpropiophenone, 4'-isopropyl-2-hydroxy-2-methylpropiophenone, α,α-dichloro-4-phenoxy-acetophenone, benzyl dimethyl ketal, 2,2-diethoxyacetophenone chlorothioxantone, 2-isopropylthioxantone, diethylthioxantone, 3,3-dimethyl-4-methoxybenzophenone, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropanon, α-hydroxycyclohexylphenyl ketone, 2,4,6-trimethylbenzoyldiphenylphosphine oxide, or

mixtures thereof.

27. Optical fiber according to claims 25 or 26, wherein the radiation curable composition comprises at least one photo-sensitizer (f).

28. Optical fiber according to claim 27, wherein the photo-sensitizer (f) is selected from: amines, ureas, phosphorus compounds, sulfur compounds, nitrils, or mixtures thereof.

29. Optical fiber according to any one of claims 25 to 28, wherein the polymerization initiator (c) and the photo-sensitizer (f) are present in the radiation curable composition in a total amount of from 0.01% by weight to 10% by weight with respect to the total weight of said radiation curable composition.

30. Optical fiber according to any one of claims 16 to 29, wherein the radiation curable composition comprises at least one monofunctional reactive diluent monomer (d).

31. Optical fiber according to claim 30, wherein the monofunctional reactive diluent monomer (d) is selected from: 2-hydroxyethyl (meth)acrylate; 2-hydroxypropyl (meth)acrylate; 2-ethylhexyl (meth)acrylate; butoxyethyl (meth)acrylate; tetrahydrofurfuryl (meth)acrylate; linear or branched alkyl (meth)acrylates such as, butyl (meth)acrylate, octyl-(meth)acrylate, decyl (meth)acrylate, tridecyl (meth)acrylate, stearyl (meth)acrylate, lauryl (meth)acrylate, isodecyl (meth)acrylate); n-hexyl (meth)acrylate; cyclohexyl (meth)acrylate; isobornyl (meth)acrylate; ethoxylated alkyl (meth)acrylates such as methoxyethyl (meth)acrylate, ethoxyethyl (meth)acrylate, butoxyethyl (meth)acrylate, 2-(2-ethoxyethoxy)ethyl (meth)acrylate; dicyclopentenyl (meth)acrylate; diethylene glycol (meth)acrylate; ethoxydiethylene glycol (meth)acrylate; benzyl

(meth)acrylate; polyethylene glycol(meth)acrylate; polypropylene glycol (meth)acrylate; methoxypolyethylene glycol (meth)acrylate; methoxypolypropylene glycol (meth)acrylate; 2-phenoxyethyl (meth)acrylate; phenoxypolyethylene glycol (meth)acrylate; alkylphenoxyethyl (meth)acrylate such as nonylphenoxyethyl (meth)acrylate; alkylphenoxypolyalkylene glycol (meth)acrylate; 2-hydroxy-3-phenyloxypropyl (meth)acrylate; tetra-hydrofurfuryloxypropylalkylene glycol (meth)-acrylate; dicyclopentenyloxypolyalkylene glycol (meth)acrylate; 2-hydroxyalkyl(meth)acryloyl phosphate; polyfluoroalkyl (meth)acrylate; N-vinyl pyrrolidone; N-vinyl caprolactam; diacetone (meth)acrylamide; isobutoxymethyl (meth)acrylamide; N,N-dimethyl acrylamide; t-octyl (meth)acrylamide; dialkylaminoethyl (meth)acrylate; (meth)acryloylmorpholine; or mixtures thereof.

32. Optical fiber according to claim 31, wherein the monofunctional reactive diluent monomer (d) is isobornyl acrylate, 2-phenoxyethyl acrylate, nonylphenoxyethyl acrylate, C_8-C_{13} alkyl acrylates, lauryl acrylate, isodecyl acrylate.

33. Optical fiber according to any one of claims 30 to 32, wherein the monofunctional reactive diluent monomer (d) is present in the radiation curable composition in an amount of from 3% by weight to 25% by weight with respect to the total weight of said radiation curable composition.

34. Optical fiber according to any one of claims 16 to 33, wherein the radiation curable composition comprises at least one adhesion promoter (e).

35. Optical fiber according to claim 34 wherein the adhesion promoter (e) is an organo-functional silanes selected from: octyltriethoxysilane, methyltriethoxysilane, methyltrimethoxysilane,

tris(3-trimethoxysilylpropyl)isocyanurate, vinyltriethoxysilane, vinyltrimethoxysilane, vinyltris(2-methoxyethoxy)silane, vinylmethyldimethoxysilane, γ-methacryloxypropyltrimethoxysilane, β-(3,4-epoxycyclohexyl)ethyltrimethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-mercaptopropyltrimethoxysilane, organo-modified polydimethylsiloxane, γ-ureidopropyltrialkoxysilane, γ-ureidopropyltrimethoxysilane, γ-isocyanatepropyltriethoxysilane, or mixtures thereof.

36. Optical fiber according to claim 34, wherein the adhesion promoter (e) is represented by the following structural formula (IV):

$$(R)_3Si-C_nH_{2n}-X \quad (IV)$$

wherein the groups R, which may be identical to or different from each other, are chosen from: alkyl, alkoxy or aryloxy groups or from halogen atoms, on condition that at least one of the groups R is an alkoxy or aryloxy group; n is an integer between 1 and 6 inclusive; X is a group selected from: nitrous, mercapto, epoxide, vinyl, imido, chloro, $-(S)_mC_nH_{2n}-Si-(R)_3$ wherein m and n are integers between 1 and 6 inclusive and the groups R are defined as above.

37. Optical fiber according to any one of claims 34 to 36, wherein the adhesion promoter (e) is present in the radiation curable composition in an amount of from 0.1% by weight to 2.5% by weight with respect to the total weight of said radiation curable composition.

38. Radiation curable composition comprising:

(a) from 50% by weight to 95% by weight with respect to the total weight of said radiation curable composition, of at least one ethylenically unsaturated polyurethane having a glass transition temperature (T_g) comprised

between -40°C and -100°C;

(b) from 5% by weight to 50% by weight with respect to the total weight of said radiation curable composition, of at least one polyfunctional reactive diluent monomer.

39. Radiation curable composition according to claim 38, wherein the ethylenically unsaturated polyurethane (a) is defined according to any one of claims 18 to 22.

40. Radiation curable composition according to claims 38 or 39, wherein the polyfunctional reactive diluent monomer (b) is defined according to claims 23 or 24.

41. Radiation curable composition according to any one of claims 38 to 40, which comprises at least one polymerization iniziator (c) which is defined according to claims 25 or 26.

42. Radiation curable composition according to claim 41, which comprises at least one photo-sensitizer (f) which is defined according to any one of claims 27 to 29.

43. Radiation curable composition according to any one of claims 38 to 42, which comprises at least one monofunctional reactive diluent monomer (d) which is defined according to any one of claims 30 to 33.

44. Radiation curable composition according to any one of claims 38 to 43, which comprises at least one adhesion promoter (e) which is defined according to any one of claims 34 to 37.

45. Radiation curable composition according to any one of claims 38 to 44, having a Brookfield viscosity comprised between 1000 m.Pa.sec and 4000 m.Pa.sec in a temperature range of from 20°C to 80°C.

46. Method for controlling the attenuation losses caused by microbending on the signal transmitted by an optical fiber comprising an internal glass portion, which comprises providing at least one

protective coating layer disposed to surround said glass portion, wherein said protective coating layer has a modulus of elasticity value between -40°C and +60°C comprised between 5 MPa and 600 MPa.

47. Method according to claim 46, wherein the modulus of elasticity value between -40°C and +60°C is not higher than 500 MPa.

48. Method according to claim 47, wherein the modulus of elasticity value between -40°C and +60°C is not higher than 450 MPa.

49. Method according to claim 48, wherein the modulus of elasticity value between -40°C and +60°C is not higher than 300 MPa.

50. Method according to claim 46, wherein the modulus of elasticity value between -40°C and +60°C is not lower than 8 MPa.

51. Method according to claim 50, wherein the modulus of elasticity value between -40°C and +60°C is higher than 12 MPa.

52. Method according to any one of claims 47 to 51, wherein said protective coating layer is defined according to any one of claims 16 to 37.